

SYSTEMATIC RISK AND LEVELS OF UNSYSTEMATIC RISK IN THE PHILIPPINE CAPITAL MARKET: A MODIFIED CAPITAL ASSET PRICING MODEL?

By

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INTRODUCTION

The Problem

This paper aims to determine the extent to which the Portfolio Theory and the Capital Asset Pricing Model (CAPM) are valid and applicable as major segments of Capital Market Theory within the Philippine capital market context.

The problem of the research work is to determine the risk return characteristics of financial assets under portfolio terms in the Philippine capital market. Specifically, the following sub-problems are to be examined:

1. The mean and variance characteristics of securities listed in the Manila Stock Exchange
2. The mean and variance characteristics of randomly drawn portfolios of securities listed in the Manila Stock Exchange
3. The empirical relationship between total risk and portfolio size
4. The level and behavior of systematic and unsystematic risk and return.

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The Capital Market Theory at this moment may be properly viewed as a special case of the much broader framework of procedures for evaluating sets of risky, interrelated investments. This framework is in turn only a part of the larger issues of uncertainty dealt with by Fisher in his work on the theory of interest (8).

A general framework for evaluating risky investments was developed by Lutz and Lutz (13), synthesized by Farrar (7), and surveyed by Masse' (16). From the framework evolved two major branches. Naslund and Whinston (18), pp. 184-200), Charnes and Cooper (3), Charnes *et al* (2), Weingartner (22) and Hillier (10) are representatives of the straight mathematical programming path which is useful in various problems of capital budgeting under uncertainty and capital rationing. The other branch developed the modern capital market theory — general equilibrium models determining capital asset prices under conditions of uncertainty. The genesis of this path is generally attributed to Markowitz (14, pp. 77-91), Arrow (1), and Debreu (4), who represented two schools of thought: the mean-variance models of Markowitz and the state preference models of Arrow-Debreu.

Markowitz treated investor portfolio selection as a static model under uncertainty. He showed how to determine optimal participation levels of securities in a portfolio which provides the most suitable combination of expected rate of return and variability of rate of return. His treatment of the portfolio problem was almost entirely normative, dealing with the special case in which investor preferences are assumed to be defined over the mean and variance of the probability distribution of single period portfolio returns. This seminal effort generated positive implications, giving rise in turn to two major lines of effort: Tobin (21, pp. 65-85) drew implications relative to demand for cash balances while Sharpe (19, pp. 425-442), Lintner (12, pp. 13-37), Mossin (17, pp. 768-783) and Fama (6, pp. 29-40) derived general equilibrium models of asset prices. Common to these models are the following assumptions:

1. All investors are single-period maximizers of expected utility of terminal wealth, who choose from among alternative portfolios on the basis of the mean and variance (or standard deviation) of the returns of these portfolios.
2. All investors can borrow or lend an unlimited amount at an exogenously given risk-free rate of interest, with no restrictions on short sales of any asset.
3. All investors have homogenous probability distributions

of means, variances and covariances of return among all assets.

4. All assets are perfectly divisible and perfectly liquid: all assets are marketable, and there are no transaction costs.

5. There are no taxes.

6. Investors are price takers.

7. Quantities of all assets are given.

Under these assumptions, the CAPM directly evolved, demonstrating that we can derive the individual's demand function for assets, aggregate these demands to obtain the equilibrium prices (or expected returns) of all assets, and then eliminate all the individual information to obtain market equilibrium prices (or expected returns) solely as a function of potentially measurable market parameters.

Both the Portfolio Theory (as developed by Markowitz) and the CAPM (as developed by Sharpe, Lintner, Mossin, *et al*) are encompassed by the Capital Market Theory. However, the CAPM is an extension of the Portfolio Theory and the determination of prices of assets. The Portfolio Theory tells us how investors behave; the Capital Market Theory, as a whole, describes the relationship which will result in equilibrium if investors behave in the manner prescribed by the Portfolio Theory.

Research Methodology

Assumptions

This study is a test of the CAPM with special focus on risk-return characteristics of individual securities, portfolios of securities, and the market portfolio. The major assumptions to be made are:

a. Capital markets of sufficient specificity for purposes of identification already exist in the Philippines, and are of sufficient scope to warrant empirical study.

b. The seven major assumptions of the CAPM are applicable to Philippine counterpart capital markets.

c. The mean variance approach to the CAPM is more applicable at present than the state preference approach.

d. The state-of-the-art cannot handle the full range of capital assets (e.g., jewelry, buildings, real estate, etc.) such that only marketable assets in organized exchanges are considered appropriate for the empirical test of the CAPM.

e. The prime representative of the Philippine capital markets is the Manila Stock Exchange (MSE); other exchanges, stock or otherwise, have less scope than the Manila Stock Exchange.

f. The universe of capital assets in terms of liquidity and marketability is properly represented by the universe of securities listed in the Manila Stock Exchange.

g. The Market Portfolio, composed of all securities in the MSE, is *the* capital market indicator or total investment performance index.

h. Intertemporal comparisons of portfolios relative to the market portfolio can be efficiently done on a random basis, precluding the identification of market and industry factors in stock price behavior.

It is worth noting that while the foregoing assumptions are quite restrictive, they are needed to empirically test the capital market theory. One of the major problems which has plagued attempts to predict the behavior of capital markets is the absence of a body of positive micro-economic theories dealing with conditions of returns in an environment of risk. The foregoing assumptions are therefore needed to start the empirical investigation and will be tested and discussed later. Without these assumptions, the analysis will degenerate into polemics.

Data Used

The raw input data in this study consist of *ex post* (realized) measures of returns for all securities listed in the Manila Stock Exchange (MSE) from January 1965 to June 1975. The data source is the MSE's *Monthly Review* which provides the monthly summaries of trading for each security.

While the original CAPM paradigm is based on *ex ante* (expected) returns, it has been noted that investors' expectations are not directly measurable proxy variables. The assumption most commonly made in earlier empirical studies is the one used by Sharpe: that investors were infallibly prescient in predicting both the variability and levels of future returns (20, pp. 416-422). This rationale was used to justify the use of *ex post* values as surrogates for investor's expectations. Hence, this study uses the rates of returns observed in the past as proxy variables for the uncertainty of investors' expectations.

Frequency of Observations

Since the input data are available monthly, it would be possible to measure the stability of the rates of return using monthly observations, or to derive observations on a quarterly or annual basis. However, it is desirable to take observations more frequently than

on an annual basis since significant fluctuations in returns, such as those due to changes in dividend payments, the effect of earnings, or other material information, may take place during the year. Therefore, monthly observations seem to be the best basis for measuring fluctuations of the rates of return for this study.

Risk and Return

Securities listed in the MSE numbered from 97 in 1965 (inclusive of 2 new issues listed and 3 delisted) to 226 in 1975 (with 21 new issues listed during the year).

The *ex post* return per security is the sum of the price of a security at the end of a period plus any dividends or other distributions paid during the period divided by the price of the security at the beginning of the period.¹ The equation for the *ex post* return is:

$$R_{i+1}^k = \frac{(P_{i+1}^k + d_{i+1}^k)}{P_i^k}$$

where :

- R_{i+1}^k : value relative or computed *ex post* return for security k in period i; for i = 1 to 126 and k = 1 to 97-226
- P_{i+1}^k : closing price for period i of security k, adjusted for splits and stock dividends
- d_{i+1}^k : cash dividends per share, if any, at the end of the period i for security k
- P_i^k : beginning price for security k at start of period i

As a measure of central tendency, the geometric mean is deemed most appropriate for the data and for the purpose for which the data are used.

If the arithmetic mean is utilized as a measure of central tendency for a compound time series, an upward bias is introduced relative to the classic discounted present value rate of return (23, pp. 55-75). Based on the assumption of reinvestment of all dividends and withdrawals by the investors, the arithmetic mean rate of return

¹This is really denoted as a value relative. The rate of return is thus the value relative minus one.

for an investment over a series of successive time periods is equal to the discounted present value rate of return for the same investment *only* when the returns vary at an exactly even rate over the entire time series. To the extent that the rate of return varies between one time period and another, the arithmetic mean rate of return will be higher than the discounted present value rate of return.

Under the same assumptions, the geometric mean of the *ex post* return for the compound time series is equal to 1 plus the discounted present value rate of return for the time the investment is held. Therefore, the geometric mean of the *ex post* returns minus 1 is the appropriate measure of central tendency.

Thus, the average *ex post* return per security over the number of periods for which there are returns will be given by:

$$\bar{R}^k = \left\{ \exp \left[\frac{1}{n} \sum_{i=1}^n \log_e \left(\frac{P_{i+1}^k + d_{i+1}^k}{P_i^k} \right) \right] \right\} - 1$$

where:

\bar{R}^k : geometric mean return for security k over n periods where returns exist (given by R_i^k), compounded every period.

Just as a geometric mean represents a measure of central tendency on a logarithmic scale, the variability of rates of return also should be measured on a logarithmic scale. Specifically, the measure of variability is not the absolute amount of deviation from the geometric mean, but rather the *ratio* of an observation above the geometric mean to the geometric mean itself, and the ratio of the geometric mean to an observation below the geometric mean. Measurement of this nature is done by using the variance and standard deviation of the logarithms of the value relatives over the period covered, rather than the standard deviations of the absolute rates of return for these periods. The corresponding equations are as follows:

$$\sigma^2 = \frac{\sum_{i=1}^n (\log_e \bar{R}^k - \log_e \bar{R}_i^k)^2}{n - 1}$$

$$s = \sqrt{\frac{\sum_{i=1}^n (\log_e \bar{R}_i^k - \log_e \bar{R}_i^k)^2}{n - 1}}$$

Random Portfolios

Twenty random portfolios in the size range of 2 to 50 securities will be considered. These will be drawn from the securities composing the market portfolio with replacement, with each security given equal weights.

The average *ex post* return per security for each period will be given by:

$$\bar{R}_i^k = \left(\frac{1}{m}\right) \left(\sum_{i=1}^n R_i^k\right)$$

where:

m : portfolio size.

This form is typically used in simulation where there is no *a priori* indication of the probability distribution of the variable simulated.

The geometric mean return of each random portfolio for the entire available trading period will be given by:

$$\bar{R}_p = \exp \left[\left(\frac{1}{n} \right) \left(\sum_{i=1}^n \log_e \bar{R}_i^k \right) \right] - 1$$

where:

n : number of months

k : 2 to m , the number of securities in each random portfolio.

The variance and standard deviation will be computed as follows:

$$\sigma_p^2 = \left(\frac{1}{n - 1} \right) \left[\sum_{i=1}^n (\log_e \bar{R}_p - \log_e \bar{R}_i^k)^2 \right]$$

$$\sigma_p = \sqrt{\left[\frac{1}{n-1} \right] \left[\sum_{i=1}^n (\log_e \bar{R}_p - \log_e \bar{R}_i^k)^2 \right]}$$

In selecting the securities to compose each random portfolio, the study assumes that each security has an equal probability of being selected into each portfolio. Hence, a set of discrete random variables (integer values representing each security) will be generated by computer simulation using the uniform distribution.

The Market Portfolio

As the CAPM implies, the market portfolio is a combination of individual portfolios with investments in each outstanding security, where the investment is proportionate to the portfolio's share of the total value of securities. However, no equivalent index of market performance actually exists for the time period under consideration.

Therefore, this study will generate a market portfolio with market value weighted investments in each security. The number of securities in the market portfolio will be subjected to sufficiency of price information. For this study, information covering 12 months or more of trading will be considered sufficient.

The mean-variance characteristics of the market portfolio will be given by the following equations:

$$\bar{R}_{MP} = \left\{ \exp \left[\left(\frac{1}{n} \right) \sum_{i=1}^n \log_e \bar{R}_i^k \right] \right\} - 1$$

where:

n : greatest common number of months, and \bar{R}_i^k is as earlier defined.

$$\sigma_{MP}^2 = \left[\frac{1}{n-1} \right] \left[\sum_{i=1}^n (\log_e \bar{R}_{MP} - \log_e \bar{R}_i^k)^2 \right]$$

$$\sigma_{MP} = \sqrt{\left[\frac{1}{n-1} \right] \left[\sum_{i=1}^n (\log_e \bar{R}_{MP} - \log_e \bar{R}_i^k)^2 \right]}$$

The standard deviation of the market portfolio is defined here as the level of systematic risk.

Risk-Portfolio Size Trade-Off

The risk-return characteristics of the randomly drawn portfolios and the market portfolio will be analyzed on the basis of the following hypothesis: as the size of portfolios increases (i.e. diversification), their standard deviations will decrease asymptotically.

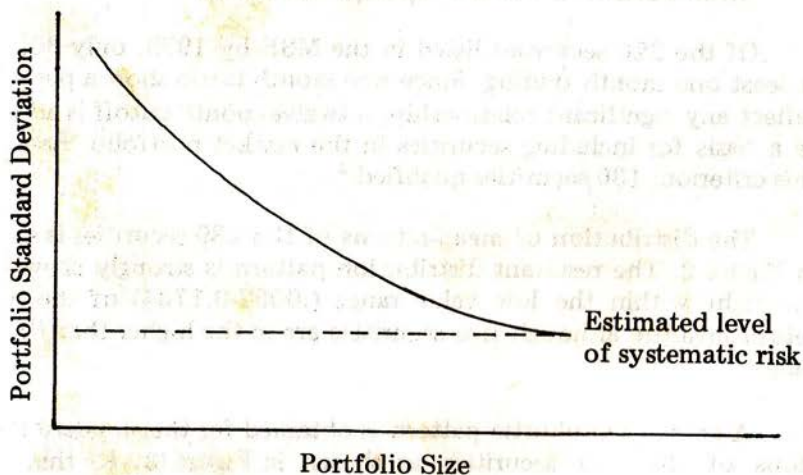
Regression analysis will be performed by fitting the following function through the least-squares method:

$$Y = B \left(\frac{1}{X} \right) + A$$

- where :
- Y : portfolio standard deviations
 - B : regression coefficient
 - X : number of securities in a portfolio
 - A : the asymptote

The expected relationship is a rectangular hyperbola function with a positive asymptote as shown in Figure 1 below:

FIGURE 1
Hypothesized Risk-Return Pattern of Random Portfolios



Apart from the parameter values, the coefficient of determination will be derived. Since the reduction of standard deviations means reduction of unsystematic risk, t-tests on successive mean portfolio standard deviations will be made which should indicate the significance of successive increases in portfolio size. It is assumed

that all dividends are reinvested, and that no withdrawals are made from the portfolio.

Stationarity Test of Systematic Risk and Return

To determine the intertemporal behavior of systematic risk and return, the risk-return characteristics of the market portfolio will be derived annually. A linear regression will be made where the regression coefficient will determine the slope or stationarity (i.e., β should approach 0) and the coefficient of determination will provide a measure of linearity (i.e., r^2 should approach unity). The mean and standard deviations of each year will be graphed as a function of time. Answers to the following questions will be determined:

1. Is systematic risk linear or non-linear over the period under study?
2. Is it horizontal, rising or falling over the period under study?
3. Is the return-time function linear or non-linear?
4. Is it horizontal, falling or rising?
5. Is there a reasonable correspondence between risk and return — is it rising, stationary risk compensated by rising, stationary or falling return?

Mean-Variance Results of Specific Securities

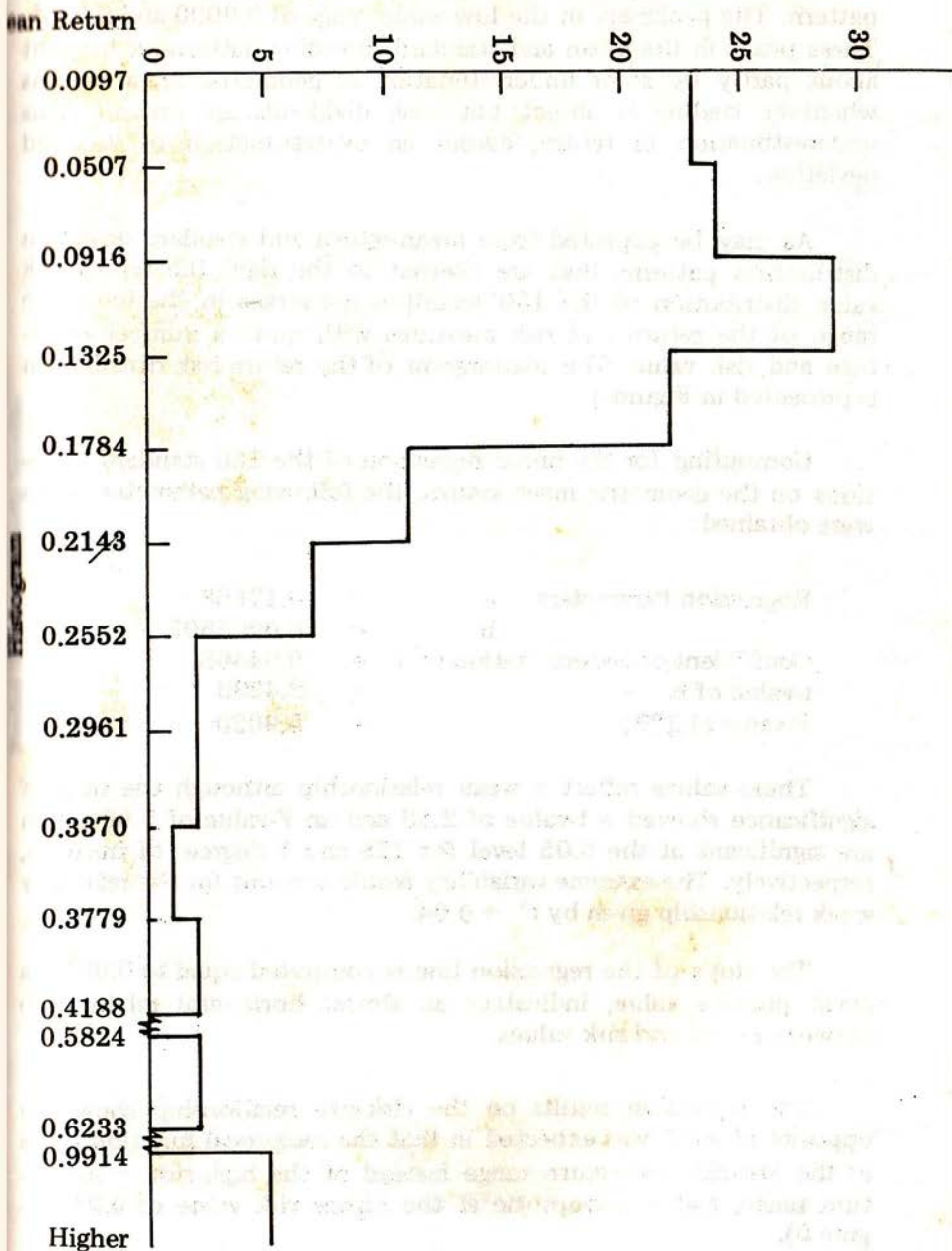
Of the 226 securities listed in the MSE by 1975, only 201 had at least one month trading. Since one month is too short a period to reflect any significant relationship, a twelve-month cutoff is adopted as a basis for including securities in the market portfolio. Based on this criterion, 130 securities qualified.²

The distribution of mean-returns of the 130 securities is shown in Figure 2. The resultant distribution pattern is strongly skewed to the right within the low value range (.0097-0.1734) of the mean return measure although five securities are in the higher than 0.9999 range.

A similar leptokurtic pattern is obtained for the standard deviations of the 130 securities as shown in Figure 3. In this case, however, there is a relatively longer right tail and about 34 securities

²An annually rebalanced market portfolio would have more than 130 securities. However, since long-term relationships are being derived in this research, rebalancing was not performed.

Number of Securities



bunched in the upper ranges (0.7675 and higher) of the standard deviation measure. Compared to the mean-return distribution, the standard deviation distribution has a more pronounced leptokurtic pattern. The peaks are in the low-value range of 0.0000 and 0.0355. These peaks in the mean and standard deviation pattern are brought about partly by some underestimation of geometric mean returns whenever trading is absent but cash dividends are present. This underestimation in return, causes an overestimation of standard deviation.

As may be expected from mean-return and standard deviation distribution patterns that are skewed to the right the return risk value distribution of the 130 securities converges in the low-value range of the return and risk measures with quite a number of return and risk value. The scattergram of the return-risk distribution is presented in Figure 4.

Computing for the linear regression of the 130 standard deviations on the geometric mean return, the following parameter values were obtained:

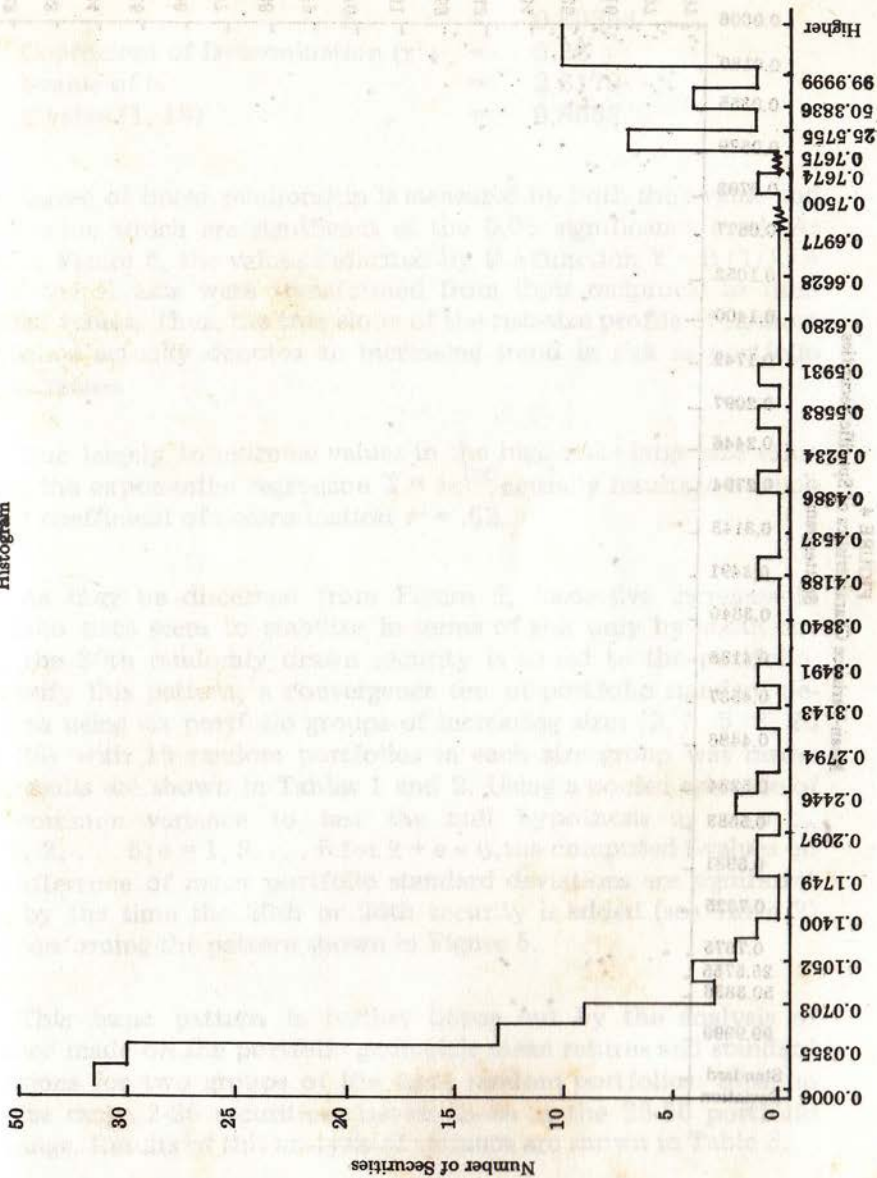
Regression Parameters	a	=	0.17668
	b	=	0.0005807
Coefficient of Determination (r^2)		=	0.04408
t-value of b		=	2.4296
F-value (1,128)		=	5.9020

These values reflect a weak relationship although the tests of significance showed a t-value of 2.43 and an F-value of 5.90 which are significant at the 0.05 level for 128 and 1 degree of freedom, respectively. The extreme variability would account for the relatively weak relationship given by $r^2 = 0.04$.

The slope of the regression line is computed equal to 0.0006, a small positive value, indicating an almost horizontal relationship between return and risk values.

The regression results on the risk-size relationship show the opposite of what was expected in that the reciprocal function starts at the low-risk low-return range instead of the high-risk — low return range, and is asymptotic at the higher risk value of 0.34 (Figure 5).

Histogram



Results obtained from the linear regression of the reciprocal return values on the portfolio standard deviations are as follows:

Regression Parameters	a	=	0.34616
	b	=	-0.69354
Coefficient of Determination (r^2)		=	0.28
t-value of b		=	2.6179
F-value (1, 18)		=	6.8533

The degree of linear relationship is measured by both the t-value and the F-value which are significant at the 0.05 significance level. As seen in Figure 5, the values indicated by the function $Y = B(1/X) + A$ on the X axis were transformed from their reciprocal to their original values. Thus, the true slope of the risk-size profile of random portfolios actually denotes an increasing trend in risk as portfolio size increases.

Due largely to extreme values in the high risk-large size value range, the exponential regression $Y = ae^{bx}$ actually results in a much higher coefficient of determination $r^2 = .62$.

As may be discerned from Figure 5, successive increases in portfolio sizes seem to stabilize in terms of risk only by about the time the 20th randomly drawn security is added to the portfolio. To verify this pattern, a convergence test of portfolio standard deviations using six portfolio groups of increasing sizes (2, 3, 5, 8, 20 and 26) with 15 random portfolios in each size group was made. The results are shown in Tables 1 and 2. Using a pooled estimate of the common variance to test the null hypothesis $u_k = u_{k+e}$ $k = 1, 2, \dots, 5; e = 1, 3, \dots, 5$ for $k + e = 6$, the computed t-values on the difference of mean portfolio standard deviations are significant only by the time the 20th or 26th security is added (see Table 2) thus confirming the pattern shown in Figure 5.

This basic pattern is further borne out by the analysis of variance made on the portfolio geometric mean returns and standard deviations for two groups of the same random portfolios: those in the size range 2-25 securities *vis-a-vis* those in the 26-50 portfolio size range. Results of this analysis of variance are shown in Table 3.

Using market value weights of specific securities and deriving the standard deviation of the market portfolio as the proxy index of systematic risk, results of the intertemporal behavior of systematic

FIGURE 5
Risk-Size Characteristics of Random Portfolios

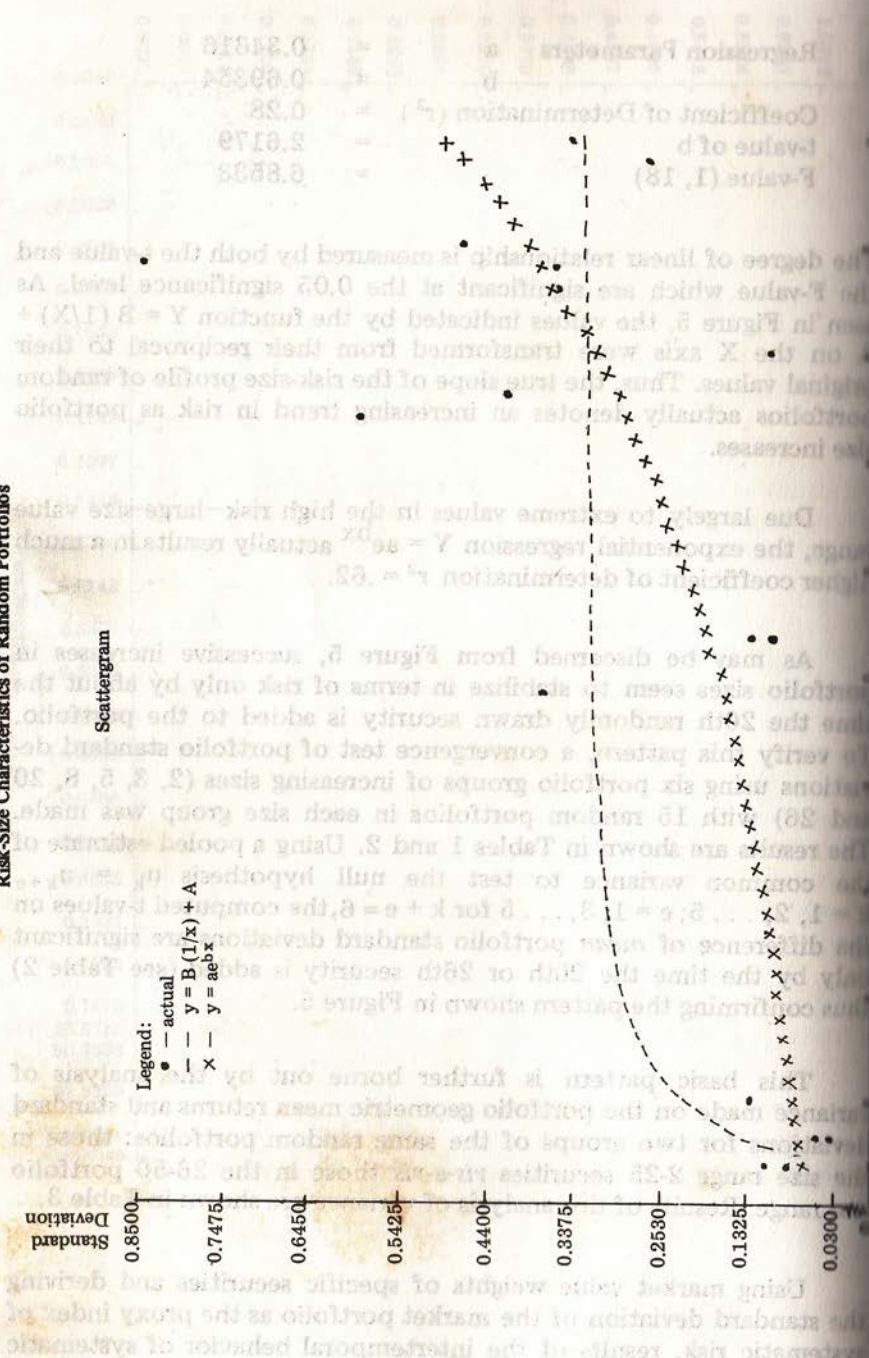


TABLE 1

**Convergence Test of Portfolio Standard Deviations:
15 Random Portfolios**

Portfolio Number	Portfolio Standard Deviations By Size					
	2	3	5	8	20	26
1	0.0311	0.1909	0.0985	0.0925	0.2954	0.2276
2	0.0122	0.2159	0.2012	0.3686	0.2184	0.2227
3	0.0550	0.0433	0.0992	0.3255	0.1018	0.6206
4	0.1063	0.0351	0.0365	0.1078	0.2364	0.0664
5	0.0016	0.0510	0.5291	0.3927	0.3792	0.4258
6	0.1944	0.1034	0.3917	0.0541	0.0734	0.0662
7	0.5607	0.0676	0.3995	0.6940	0.3724	0.2046
8	0.1832	0.0914	0.0888	0.0396	0.2914	0.6628
9	0.4565	0.3566	0.0310	0.2849	0.2058	0.2214
10	0.0148	0.1926	0.1240	0.1741	0.3454	0.3793
11	0.2052	0.0451	0.1725	0.0886	0.1346	0.1172
12	0.0446	0.1364	0.0512	0.0665	0.2209	0.2013
13	0.0785	0.0839	0.0471	0.3613	0.3713	0.2775
14	0.1874	0.0778	0.0331	0.1788	0.3199	0.2023
15	0.0030	0.0420	0.0983	0.0856	0.3055	0.4246
Mean (\bar{S})	0.1423	0.1155	0.1601	0.2210	0.2581	0.2880
Variance σ^2 (\bar{S})	0.02796	0.00799	0.02426	0.03311	0.00976	0.03277

TABLE 2

**Computed t-Values for Convergence Test:
15 Random Portfolios Per Portfolio Size**

Portfolio Size	2	5	8	20	26	
2	—	0.5474	-0.3017	-1.2334	-2.3091*	-2.2898*
3	—	—	-0.9618	-2.0155	-4.1445*	-3.3088*
5	—	—	—	-0.9848	-2.0578*	-2.0742*
8	—	—	—	—	-0.6940	-1.0100
20	—	—	—	—	—	-0.5615

*Significant at 0.05 confidence level.

TABLE 3

Analysis of Variance
20 Random Portfolios Grouped Into Sizes
25 Securities and Less vs. 26 Securities and More

	Portfolio Mean Returns	Standard Deviations
Total Sum of Squares	0.0214	0.8752
Between Sum of Squares	0.0146	0.2282
Within Sum of Squares	0.0068	0.6470
Total Degrees of Freedom	19	19
Between Degrees of Freedom	1	1
Within Degrees of Freedom	18	18
F-Value (1, 18)	38.4507	6.3496

Note: The computed F-values for both returns and standard deviations, are significant at the 0.05 significance level, where $F(1, 18)$ at 0.05 = 4.41.

TABLE 4

Intertemporal Returns and Standard Deviations
of the Market Portfolio 1965-1975

Year	Geometric Mean-Return	Standard Deviation	Number of Securities Included
1965	0.0700	0.3077	73
1966	0.0596	0.9967	78
1967	0.0818	1.9282	77
1968	0.0631	0.8616	79
1969	0.1002	0.4917	84
1970	0.0807	0.1434	100
1971	0.0573	0.1510	93
1972	0.0769	0.4207	104
1973	0.1101	0.2123	124
1974	0.1029	0.4739	143
1975*	0.0724	0.1491	108

*January to June

risk, over the period 1965-75 are shown in Figure 6. Details of the computation are summarized in Table 4.

The general trend of market risk is downward where the average for the first five years (0.9172) is much higher than that for the succeeding six years (0.2584).

The linear regression results are:

$$\begin{aligned} \text{Regression Parameters } a &= 1.9282 \\ b &= -0.0841 \end{aligned}$$

$$\text{Coefficient of Determination } (r^2) = 0.27$$

$$\text{t-value of } b = 1.826$$

$$\text{F-value } (1,9) = 3.34$$

The slope of -0.0841 describes a steep decline in systematic risk over the period studied. However, the computed F-value is insignificant at the 0.05 level of significance, where $F(1,9) = 5.12$; and at the 0.10 significance level where $F(1,9) = 3.36$.

Results of the intertemporal behavior of market returns over the same period are presented in Figure 7. The pattern obtained is the opposite of the risk behavior in that there is a gentle upward trend in market returns as denoted by the slope of 0.00232, with the following results of the linear regression:

$$\begin{aligned} \text{Regression Parameters } a &= 0.06565 \\ b &= 0.00232 \end{aligned}$$

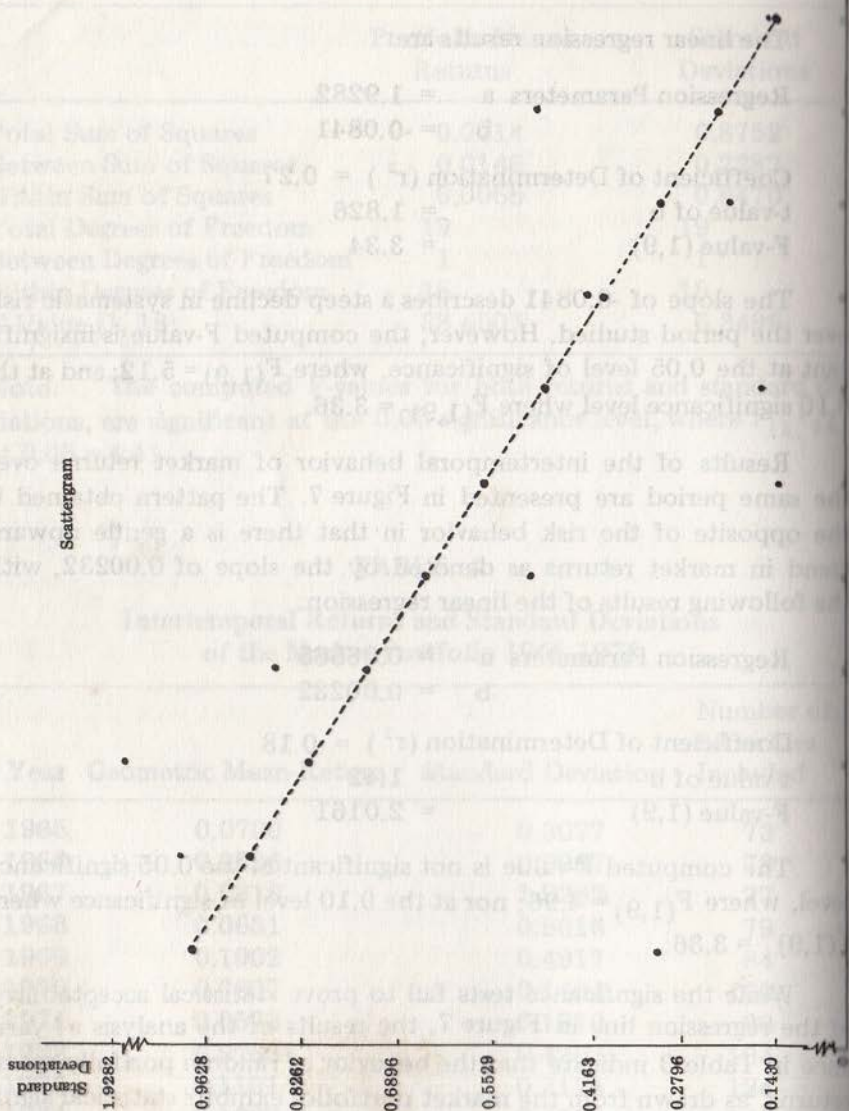
$$\text{Coefficient of Determination } (r^2) = 0.18$$

$$\text{t-value of } b = 1.42$$

$$\text{F-value } (1,9) = 2.0161$$

The computed F-value is not significant at the 0.05 significance level, where $F(1,9) = 4.96$; nor at the 0.10 level of significance where $F(1,9) = 3.36$.

While the significance tests fail to prove statistical acceptability of the regression line in Figure 7, the results of the analysis of variance in Table 3 indicate that the behavior of random portfolio mean returns, as drawn from the market portfolio, exhibits statistical significance. Since the market portfolio used as a basis for Table 3 was drawn from 130 qualified securities over the period covered by Figure 7, then the statistical insignificance of the Figure 7 regression parameters is alleviated.



As earlier stated, the primary objective of this paper is to determine the extent of validity of the Portfolio Theory and the CAPM within the Philippine capital market. Toward this end, the study has arrived at four major findings which are discussed and interpreted in detail below.

Briefly, the CAPM as developed by Sharpe and Lintner indicates that under certain assumptions the relationship between the expected return on a portfolio and its expected variance is linear if the portfolio is efficient or if the portfolio provides the maximum return for a given level of risk and vice versa, the minimum risk for a given level of return. The model is illustrated in Figure 8. The vertical axis represents the expected return of each portfolio and the horizontal axis represents the corresponding variance or standard deviation. The line R_{M} in the linear function of expected return on the market portfolio and R_{i} the corresponding standard deviation. The intercept R_f represents the rate of return on a riskless security.

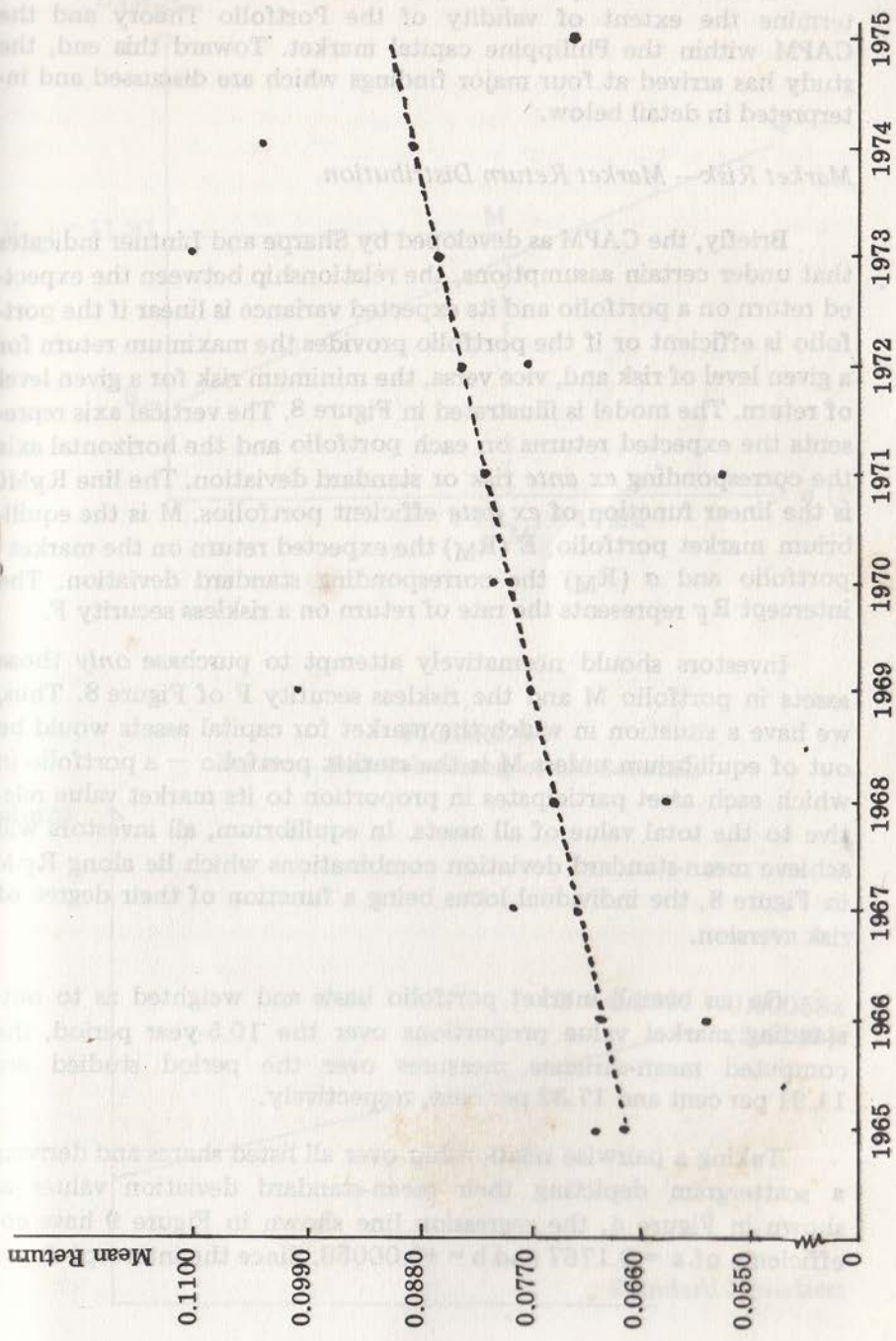
Investors should not naively attempt to purchase only those assets in portfolio M and the riskless security R_f of Figure 8. Thus, we have a reason in a capital market for capital assets would be out of equilibrium unless the market portfolio — a portfolio in which each asset participates in proportion to its market value relative to the total value of all assets in equilibrium, all investors will achieve mean standard deviation combinations which lie along R_{M} in Figure 8, the individual assets being a function of their degree of risk aversion.

Therefore, mean standard deviation portfolios have and weighted as to their market value as proportions over the 10.5 year period, the computed mean-standard deviation measures over the period studied are 11.71 per cent and 17.52 per cent, respectively.

Taking a pairwise mean-standard deviation over all listed shares and determining a corresponding regression line (see standard deviation values in Figure 9) and the regression line shown in Figure 9 has a

Market Risk - Market Return Distribution

Source: Author



Interpretations and Implications

As earlier stated, the primary objective of this paper is to determine the extent of validity of the Portfolio Theory and the CAPM within the Philippine capital market. Toward this end, the study has arrived at four major findings which are discussed and interpreted in detail below.

Market Risk – Market Return Distribution

Briefly, the CAPM as developed by Sharpe and Lintner indicates that under certain assumptions, the relationship between the expected return on a portfolio and its expected variance is linear if the portfolio is efficient or if the portfolio provides the maximum return for a given level of risk and, vice versa, the minimum risk for a given level of return. The model is illustrated in Figure 8. The vertical axis represents the expected returns on each portfolio and the horizontal axis the corresponding *ex ante* risk or standard deviation. The line $R_F M Q$ is the linear function of *ex ante* efficient portfolios. M is the equilibrium market portfolio, $E(R_M)$ the expected return on the market portfolio and $\sigma(R_M)$ the corresponding standard deviation. The intercept R_F represents the rate of return on a riskless security F.

Investors should normatively attempt to purchase *only* those assets in portfolio M and the riskless security F of Figure 8. Thus, we have a situation in which the market for capital assets would be out of equilibrium unless M is the market portfolio — a portfolio in which each asset participates in proportion to its market value relative to the total value of all assets. In equilibrium, all investors will achieve mean-standard deviation combinations which lie along $R_F M$ in Figure 8, the individual locus being a function of their degree of risk aversion.

On an overall market portfolio basis and weighted as to outstanding market value proportions over the 10.5-year period, the computed mean-variance measures over the period studied are 11.91 per cent and 17.32 per cent, respectively.

Taking a pairwise relationship over all listed shares and deriving a scattergram depicting their mean-standard deviation values as shown in Figure 4, the regression line shown in Figure 9 have coefficients of $a = 0.1767$ and $b = +0.00058$. Since the intercept shows

FIGURE 8

The Capital Asset Pricing Model

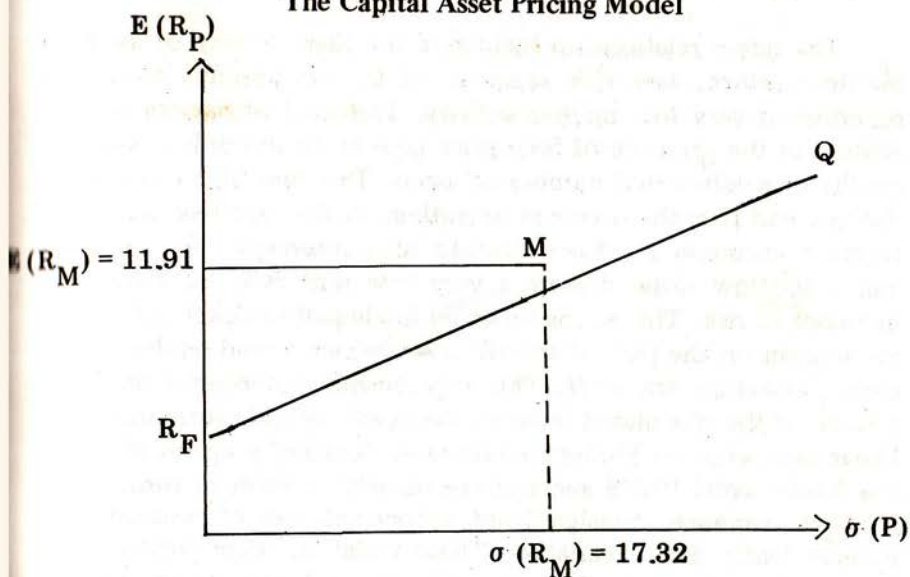
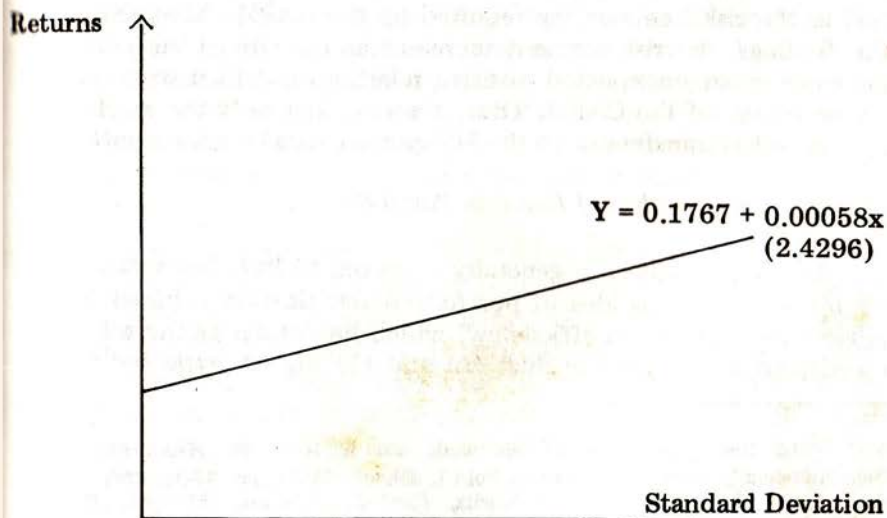


FIGURE 9

Return - Risk Relationship of 130 Securities



a much higher return to begin with, $y = .1767 + .00058X$ evaluated at $X = E(R) = 11.9$ per cent certainly will not yield point M.

The latter relationship highlights the high density of assets in the low return, low risk segment of the continuum, possibly a function of very low market activity. This kind of pattern became evident in the presence of long price gaps in the monthly risk-return profile of a substantial number of assets. This bunching of points in the low end plus the presence of outliers in the high risk low return segment accounts for the relatively high intercept. On the other hand, the low slope depicts a very low sensitivity of returns to increases in risk. This seems to be an inadequate market risk pricing mechanism on the part of specific assets which would render an efficient risk-return trade-off. This relationship underscores the significance of the postulated linearity between risk and return models: a linear regression on Philippine securities does not seem to allow for the fundamental BLUS assumptions namely, a mean of zero, homoscedastic variance, nonsignificant autocorrelation of residuals, and independently drawn variables. These violations then greatly affect market clearing prices of specific securities, which to begin with, are traded in a very thin market, with frequent absence of day-to-day trading.

The market portfolio, on the other hand, seems to follow more faithfully the expected risk-return pricing mechanism. The 11.91 per cent return of the ideal portfolio is above the 9 per cent tax-prepaid return on Central Bank Certificates of Deposit, which may be typified as the risk-free security required by the CAPM. As explained in the findings, the risk element increases as the size of the portfolio increases — an unexpected positive relationship which weakens the applicability of the CAPM. Thus, it seems that only the market return aspect is transferable to the Philippine capital market context.

Risk-Size Relationship of Random Portfolios

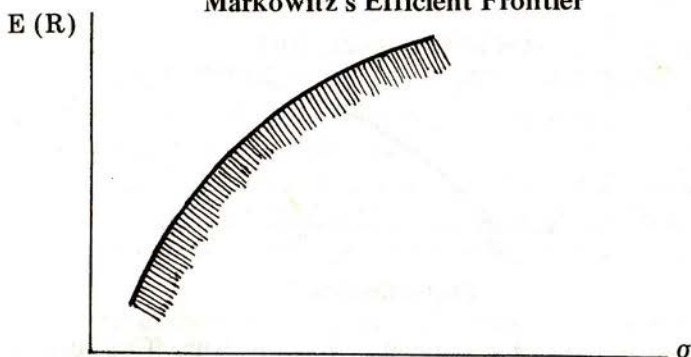
Portfolio analysis is generally accepted to have been pioneered by Markowitz.³ His idea of portfolio diversification is based on his criterion of "portfolio efficiency" which he defines as the set of securities that satisfies the dual criteria: (1) highest expected return

³The first presentation of his work was in Harry M. Markowitz, "Portfolio Selection", *Journal of Finance*, Vol. 7, (March, 1952), pp. 77-91. This he further developed in Harry M. Markowitz, *Portfolio Selection: Efficient Diversification of Investments*, (New York: John Wiley & Sons, Inc.) 1959.

for a given level of risk and (2) lowest level of risk for a given level of expected return.

His model of efficient set portfolios or efficient frontier is illustrated in Figure 10 wherein the vertical axis measures the expected return on a portfolio and the horizontal axis its associated risk. The curve represents the boundary of the efficient portfolio and the shaded area, the set of "inefficient" portfolios.

FIGURE 10
Markowitz's Efficient Frontier

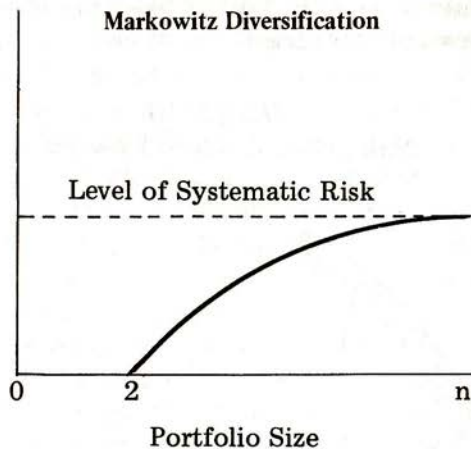


Sharpe suggests that the total variation of a portfolio return may be segregated into two forms: (1) systematic risk, resulting in the covariation of the returns on the individual assets with the market return; and (2) unsystematic risk, attributable to the peculiarities of the individual assets themselves or that portion of total risk not attributable to the variation of the market return. Thus, if the number of assets included in a portfolio were to approach the number of assets in the capital market, the variation of portfolio returns should approach the level of systematic risk — suggesting a relationship which behaves as a decreasing asymptotic function (see Figure 1).

The mirror effect of the above relationship may be called "Markowitz diversification" (9) which depicts the asymptotic function rising smoothly from the zero variance of a two-security portfolio composed of two perfectly negatively correlated assets in their optimum minimum-variance participation levels. Due to the all encompassing economic environment, risk in the minimum risk portfolio rises steadily as the size increases from two. Since there is a common economic environment, an inverse covariation between any pair of assets becomes more and more remote. Thus, even the most

desirable additional assets will contribute increasingly large positive covariances. Minimum risk therefore, asymptotically increases to the level of systematic or market risk (see Figure 11).

FIGURE 11
Markowitz Diversification



The two situations described are equivalent. The former assumes that all positively covarying assets are lumped in increasing portfolio sizes, with the consequent reduction of dispersion as market risk is approximated. The latter starts from perfectly negatively correlated assets, and gradually adds more risk as portfolio size increases.

The results of this research, however, point to a perverse relationship between size and risk. Figure 5 shows that total risk increases as portfolio size increases. The twenty randomly drawn portfolios of varying sizes from 2 to 50 exhibit increasing risk up to an upper bound of about 0.34. On the other hand, the market portfolio composed of 130 assets has a systematic risk level of only 0.1732. Based on these conflicting relationships, it would be better to purchase and hold the market portfolio, or hold a portfolio size of about 20 to 26 assets, roughly equivalent to the 0.1732 risk level, reckoning from Figure 5. In any case, it appears that on this score, the market portfolio used in this research is mean-variance efficient relative to random portfolios.⁴

⁴A discussion on the empirical relevance of accurate proxies of the market portfolio to test the validity of the CAPM is made in Stephen A. Ross, "The Current Status of the Capital Asset Pricing Model," *The Journal of Finance*, Vol. XXXIII, No. 3, (June 1978), pp. 891-894.

Non-Stationarity of Systematic Risk

Jensen has stated that if the concept of systematic risk is to be of practical use in evaluating and selecting portfolios, it must be stationary through time (11, pp. 216-217). The investor selecting a portfolio must be able to use historical data to obtain estimates which will be a good indication of future risk. Furthermore, in evaluating portfolios, we must be able to assume that the riskiness of the portfolio has not changed over the period under consideration. In general, therefore, an efficient estimate of a portfolio's risk may be obtained by using all past data.

The finding of this study on systematic risk stationarity is opposed to the usual CAPM assumption of stationarity. We have identified in Figure 6 a relatively steep decline in systematic risk over the period under study, particularly through the second half of the 10.5-year period, although there is a bit of graphical illusion in Figure 6, besides the absence of statistical significance.

The writer believes that non-stationary systematic risk is more faithful to the CAPM, in that risk changes, as well as price changes, are statistically independent in a time series. Furthermore, all past data on risk must already be impounded in the market portfolio. The shortcoming of most empirical studies regarding systematic risk has been the use of cross-sectional analysis. This study did a time series to capture the risk profile of the market portfolio.

Several reasons may be advanced for this phenomenon. First, risk perceptions of individual and institutional investors in the Philippine capital market have shifted the systematic risk downward largely due to increasing sophistication in applying investment analysis techniques. Second, efficiency in information impounding and discounting by the capital market itself has been increasing. This increasing efficiency denotes a market which rapidly evaluates a piece of information, upon which the price and risk of an asset immediately adjusts in an unbiased fashion to a new value. In such a market, it is conceivable that risk elements become much more defined, with a corresponding decline in overall market risk. This state of affairs then renders the situation amenable to portfolio diversification. A third reason is the presence of exogenous factors. One of these is improvement in scientific infrastructure. A research study along this line concluded that two innovations in communications technology (the domestic telegraph and the Atlantic cable) sig-

nificantly and rapidly narrowed inter-market price differentials. Similarly, the proliferation of telephone hot lines between the Manila and Makati Stock Exchanges was expected to contribute to systematic risk declines over the period. Another possible exogenous factor is the improvement of the economic infrastructure. The resiliency of economic policies may indeed directly affect investors' risk perceptions and consequently shift their risk-return trade-offs.

Fourth, the rapid increase in listed securities may have made the theory of rational choice for the investor more meaningful because of more choices. Besides, the opportunities of efficient diversification have spread out total risk to more assets. This was evident in the relationship between the market portfolio and randomly drawn portfolios.

Fifth, an inflationary illusion could have been at work in the minds of investors. Equities have been regarded as inflation hedges. So long as investors believe that they have fully anticipated current inflation, equities retain their attraction. If however, there is unanticipated inflation and the investors do not realize it, the systematic risk component may still decline.

All of the reasons mentioned have probably worked together in generating the decline in systematic risk, some of them working jointly, some offsetting the others.

Non-Stationarity of Systematic Return

The stability of systematic risk through time gives rise to the implication that systematic return must also be stable. The finding of a non-stationary systematic risk over the 10.5-year period would nullify this implication. Indeed, the graph of the intertemporal pattern of market return shown in Figure 7 indicates an upward sloping regression line, although almost horizontal. This result, however, is somewhat vitiated by the absence of enough statistical significance. But the variance of slopes between risk and return over the period under study cannot be ignored. The slope of 0.002 was probably the impact of the two boom years, 1969 and 1973 (first half). Excluding these two observations, the regression line is expected to be horizontal, making the market return stationary.

The prime implication here is the opportunity of approximating a market portfolio where risk is declining but uncompensated by a likewise declining return. This opportunity could be short-lived, i.e., under the CAPM the risk-return trade-off is expected to be operable—low risk, low return. It is thus very probable that the systematic

return will shortly decline.

As unanticipated inflation escalates, the expected downturn in systematic return should be met by a rising systematic risk.

Conclusions

Mainly, the study attempted to answer whether or not the CAPM is applicable to the Philippine capital market, as represented by its mean-variance measures and risk-portfolio size trade-off. The general conclusion is that applying statistical analysis to Philippine capital market assets is called for and can be done. However, we should not adopt strict adherence to CAPM tenets in the form developed by Sharpe, Lintner, Mossin, *et al.*

The Philippine Capital Market

In a macro sense, the Philippine capital market, as exemplified by the Manila Stock Exchange, has certain features that lessen the applicability of the CAPM.

First is the very thin market. In any trading day, only a small fraction of total listed shares would move in terms of ending market values. Volumes might move, but market values do only nominally. The price action of the few shares often becomes a function of the activities of one or two large brokerage houses, frequently executing cross sales, but not really contributing market broadening and deepening.

Second, the study's computer printouts have shown that there is a fairly extended hiatus of trading in many shares. Thus, for long periods, we have zero returns, non-appearance of quoted prices, weak volume, and the like, denoting a weak market.

Third, the behavior of a substantial number of shares through time show that a large segment of trading has been done on an insider information basis; i.e. an individual or group has monopolistic access to restricted information. Fortunately, insider trading carries with it its own seeds of destruction, because, in attempting to act immediately on this information, the individual group ensures that the effects of this restricted information are quickly impounded in the security's price. Therefore, while there may be windfall returns, earning these windfall returns consistently through time is not possible.

Fourth is the question of effective regulations. To the extent

that the regulations are not truly effective, perhaps it would be better to enact rules of the game and let rational expectations take over.

Fifth is the relative stability of returns compared to the associated risks, such that the range of returns is very limited compared to the risk range or standard deviations (see Figure 9). This indicates that a considerable number of variance inefficient securities exist in the Philippine capital market.

Sixth, compared to the New York Stock Exchange, the Philippine capital market, as represented by the Manila Stock Exchange, may be considered still in its infancy in terms of the number of securities listed and traded and in terms of trading volume. As may be expected of a capital market in its early development stage, the risk-return distribution pattern may be very conservative in the sense that the risk-return values of the securities traded tend to converge in the low value ranges of these measures along with a number of extreme values.

Implications to Investment Management

The first implication to investment management is the importance of defining a market weighted index based on all listed shares. Through this market index, professional investment managers will have a theoretically correct benchmark by which everybody's performance may be gauged. Standardizing performance evaluation is crucial in contributing to an efficient market. At least, what will have been discounted implicitly will be made explicitly.

The second implication is the effective range of portfolio size. Table 2 shows that 20-26 securities in a portfolio would be the relevant range, in terms of t-tests performed. However, from Figure 5, the relevant range can be 4-26 securities, in terms of risk. In terms of greater statistical significance, the 20-26 security size in terms of mean returns is more appropriate.

Third, with a market index, the market portfolio may be approximated for the benefit of clients on a simple buy and hold investment strategy. An actively traded portfolio which does not take cognizance of the market index just generates commission income for the brokers.

Fourth, fundamental analysis should be emphasized but only to support a broad-based market index configured portfolio, not to produce buy-hold-sell decisions.

Fifth, keeping track of the market index should enable investment management and trust departments to cut down substantially on overhead and useless technical analysis.

Sixth, the typical portfolio management policies of financial institutions emphasizing portfolios composed mainly of what has been institutionally perceived and classified as "blue chips" weaken the prescriptions of the CAPM. By biasing investment portfolios towards these "blue chips", the efficient frontier is in effect shifted to the right, away from the ideal tangency with the appropriate utility function.

Limitations

One limitation is the lack of a high degree of statistical significance. Modifications of the study might produce results with a higher degree of statistical significance. For instance, some statistical transformation of the input data might reduce the dispersion of the scattergrams. A logarithmic transform might be appropriate, but the empirical question that still has to be resolved is whether or not the mean returns and standard deviations will be distorted when they are transformed.

Second, by using the standard deviation, or the square root of the variance, as the measure of dispersion of logarithms of value relatives, the effect of the extreme values in the distribution of value relatives on the value of the risk factor was compounded by the squaring of the deviations. To the extent that the occurrence of these extreme values is non-stationary over time, the considerable weight accorded them in the measure of dispersion detracts from the predictive power of that measure of dispersion as an indicator of the degree of dispersion to be expected in the future.

Fama discusses the implications of the behavior of the variances in Stable Paretian distribution as follows:

"The Stable Paretian hypothesis makes two basic assertions:
(1) the variances of the empirical distributions (of logs of

value relatives) behave as if they were infinite, and (2) the empirical distributions conform best to the non-Gaussian members of a family of limiting distributions which Mandelbrot has called Stable Paretian.

The infinite variance assumption of the Stable Paretian model has extreme implications. From a purely statistical standpoint, if the population variance of the distribution of first differences is infinite, the sample variance is probably a meaningless measure of dispersion" (5, p. 421).

From a practical standpoint, the findings of the present research indicated that the standard deviation was not meaningless as a measure of dispersion, but did have some predictive power in the sense that it indicated relative future dispersion. However, the Stable Paretian Hypothesis implies that some other measure of dispersion might well prove to be more reliable as a predictor of dispersion of future outcome. It has been suggested to the author that one might experiment fruitfully with the interquartile and/or intersextile range, the mean deviation, or a power of the deviations between one and two.

Third, it should be emphasized that the findings and conclusions of this study are valid only when applied to an adequately long time span and to large groups of securities.

What constitutes an "adequately long time span" depends on the conditions prevalent in the market. Generally speaking, an adequate period covers at least one full market cycle, from one peak to the next, as measured by some broad market index. Thus, this research did not present a monthly or quarterly profile of the market portfolio's *ex post* risk and return behavior. The period under study, 1965 to 1975, was split into an annual basis and the yearly parameters derived were considered adequate, given the intertemporal objective of the analysis. In this sense, however, the usual quarterly portfolio reports and evaluations generated by investment management groups will not be served.

Also, the relationship is valid only for very large groups of stocks, particularly at higher risk levels where the dispersion of results are wide and extreme outcomes on a small minority of the total number of stocks tend to exert an important effect on the group mean.

Fourth, the research findings do not identify any cause and effect relationship between the independent variables (return or risk, respectively). Since the true cause and effect relationship is merely suggested by the analysis, but not known with any certainty, the study does not offer any direct evidence as to the extent or whether the relevant causal forces can be expected to prevail in the future.

Avenues of Further Research

The first and most obvious avenue of further research is to update the study through the end of 1978, utilizing the research design of the present study. The author hopes to accomplish this updating in the near future.

Secondly, it might be fruitful to carry out additional analyses using the same research design and comparing results achieved by using different measures of risk, such as the semi-variance, mean deviation, interquartile deviation, and the like.

Third, instead of time as the regulator of observations, intervals based on number of shares traded, number of transactions, amount of market value turned over, and so forth, may be utilized.

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